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(54) **METHOD AND APPARATUS FOR HANDLING MATERIAL IN A PNEUMATIC MATERIALS HANDLING SYSTEM**

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B65F 5/00 (2006.01)
B65G 51/02 (2006.01)

(52) **U.S. Cl.**
CPC ***B65F 5/005*** (2013.01); *B65G 53/48* (2013.01); *B65G 51/02* (2013.01)
USPC **406/70**; 406/52

(58) **Field of Classification Search**
USPC 406/70, 52, 51, 56, 108, 145
See application file for complete search history.

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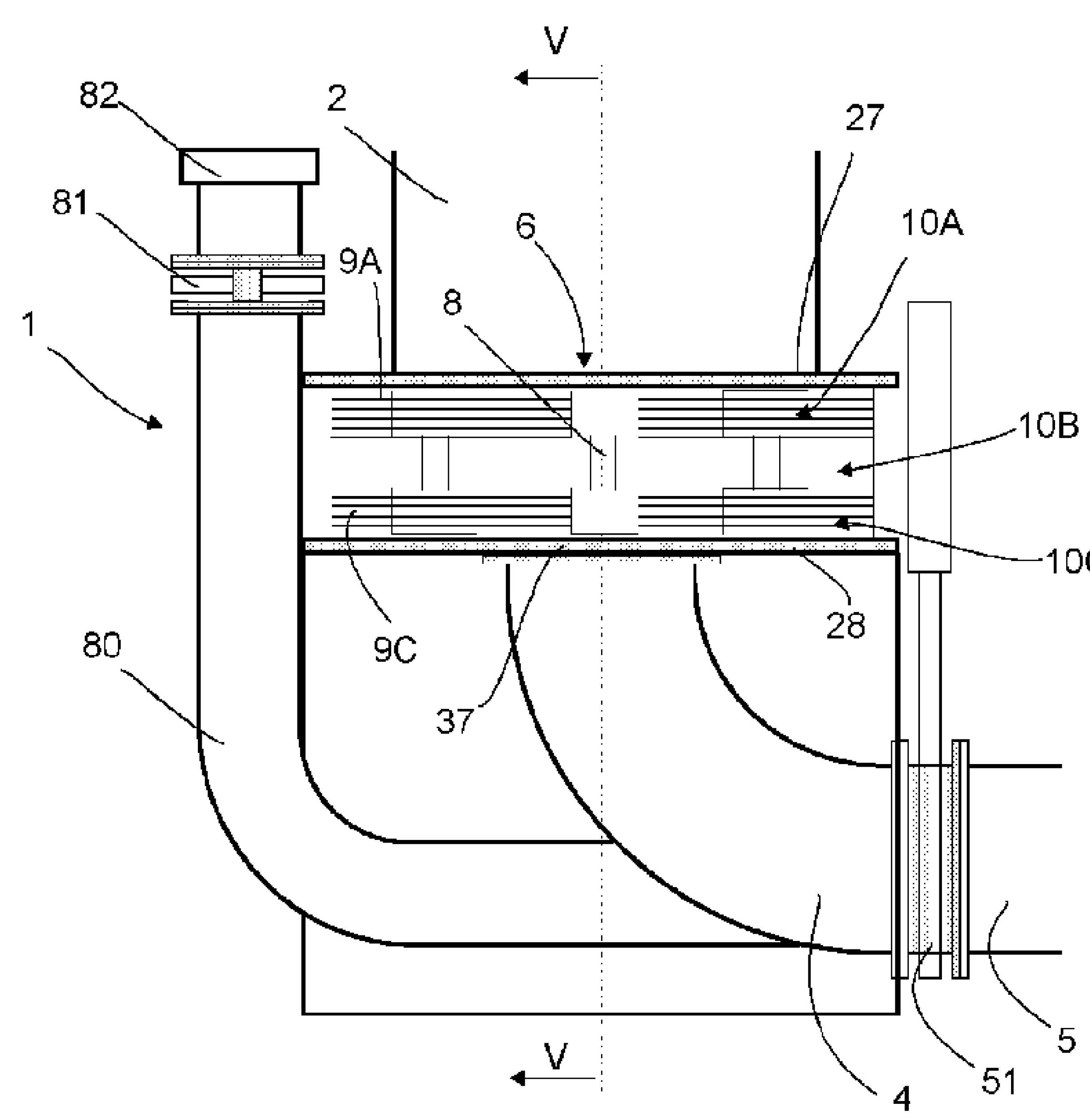
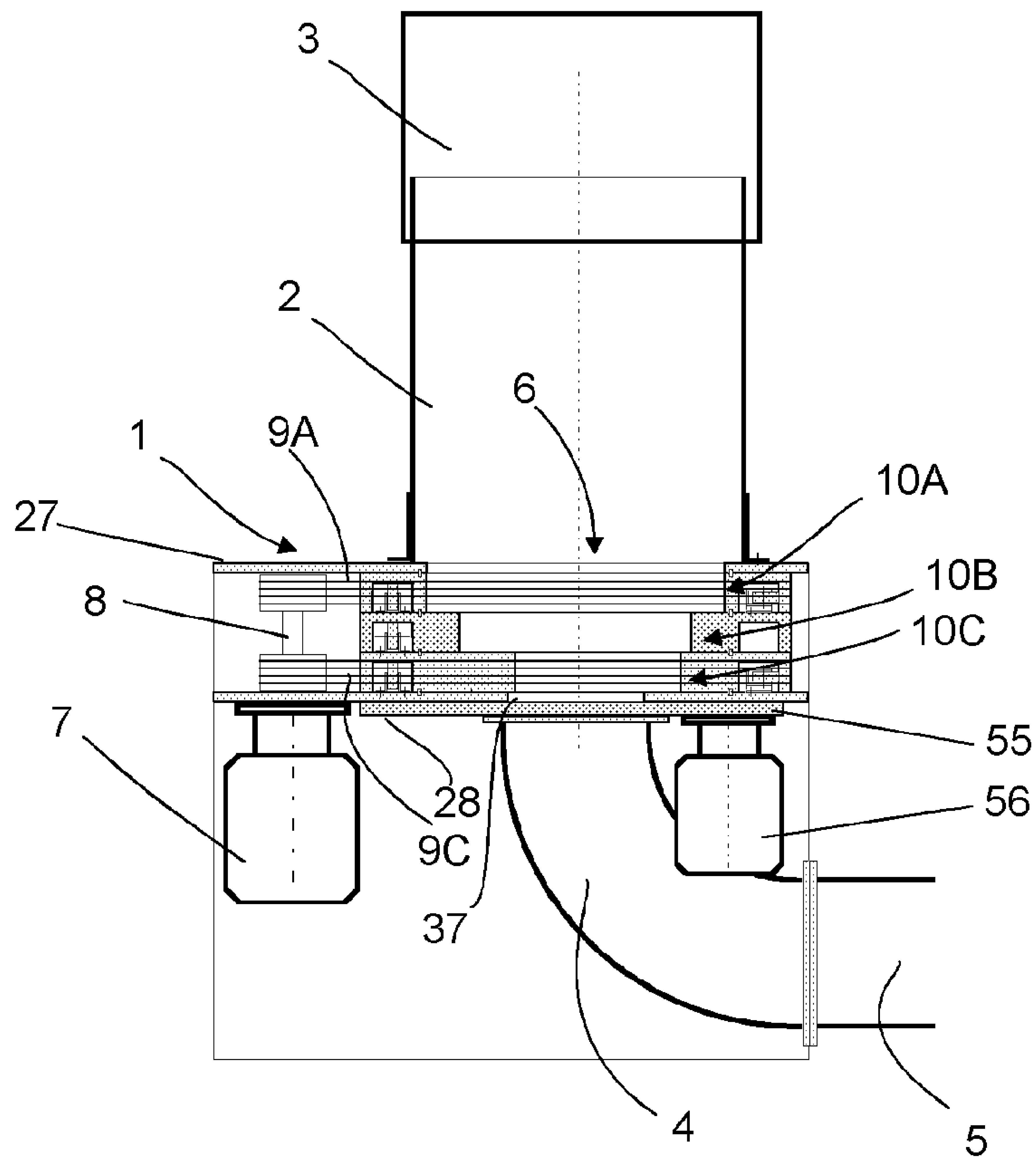
(57) **ABSTRACT**

A method for handling material in a pneumatic materials handling system, in which material is input from an input aperture of an input point and is handled with a rotary shaper, arranged in connection with the input point, to be more compact and is transferred onwards. The rotary shaper includes a rotatable handling device with an aperture, which is arranged eccentrically with respect to the axis of rotation. The rotary shaper includes at least one stationary handling device, in which case the material to be handled is conducted into and through the rotary shaper at least partly by gravity, by suction, or by a pressure difference, or at least partly by a combination of two or more of the gravity, the suction, and the pressure difference.

29 Claims, 7 Drawing Sheets




3
2
6
1
9A
27
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10B
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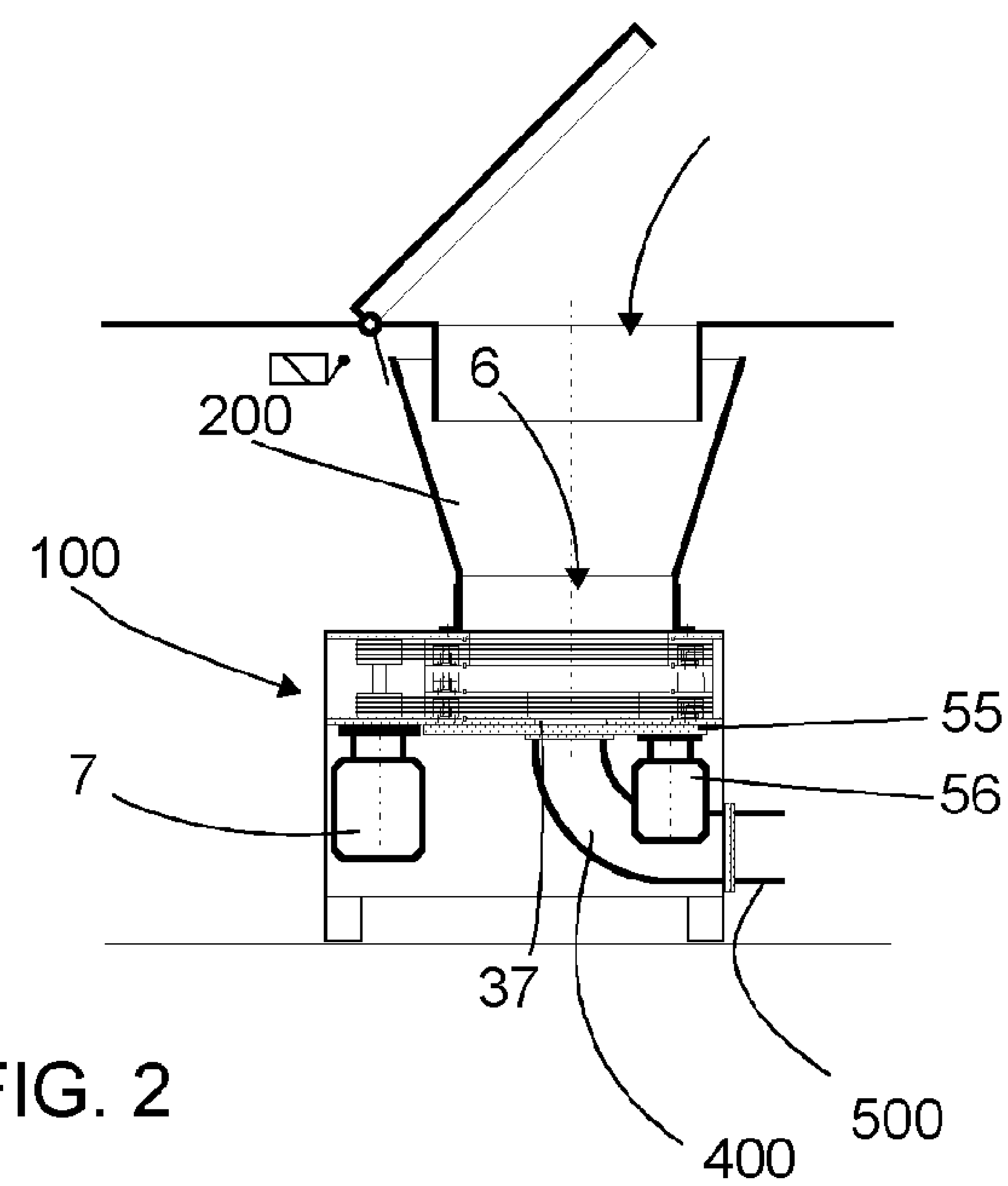
FIG. 1


6
200
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56
37
400
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FIG. 2

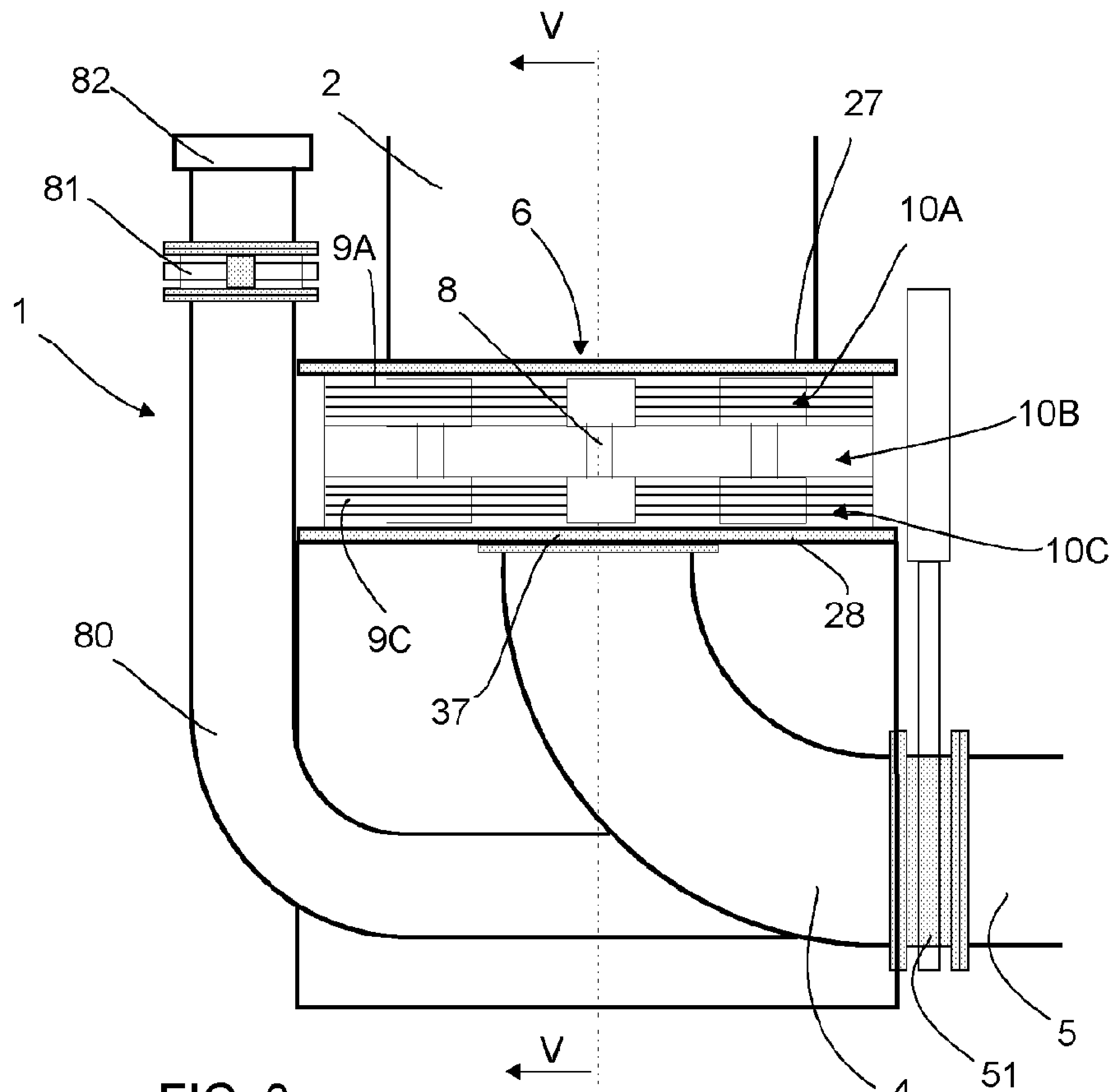

FIG. 3

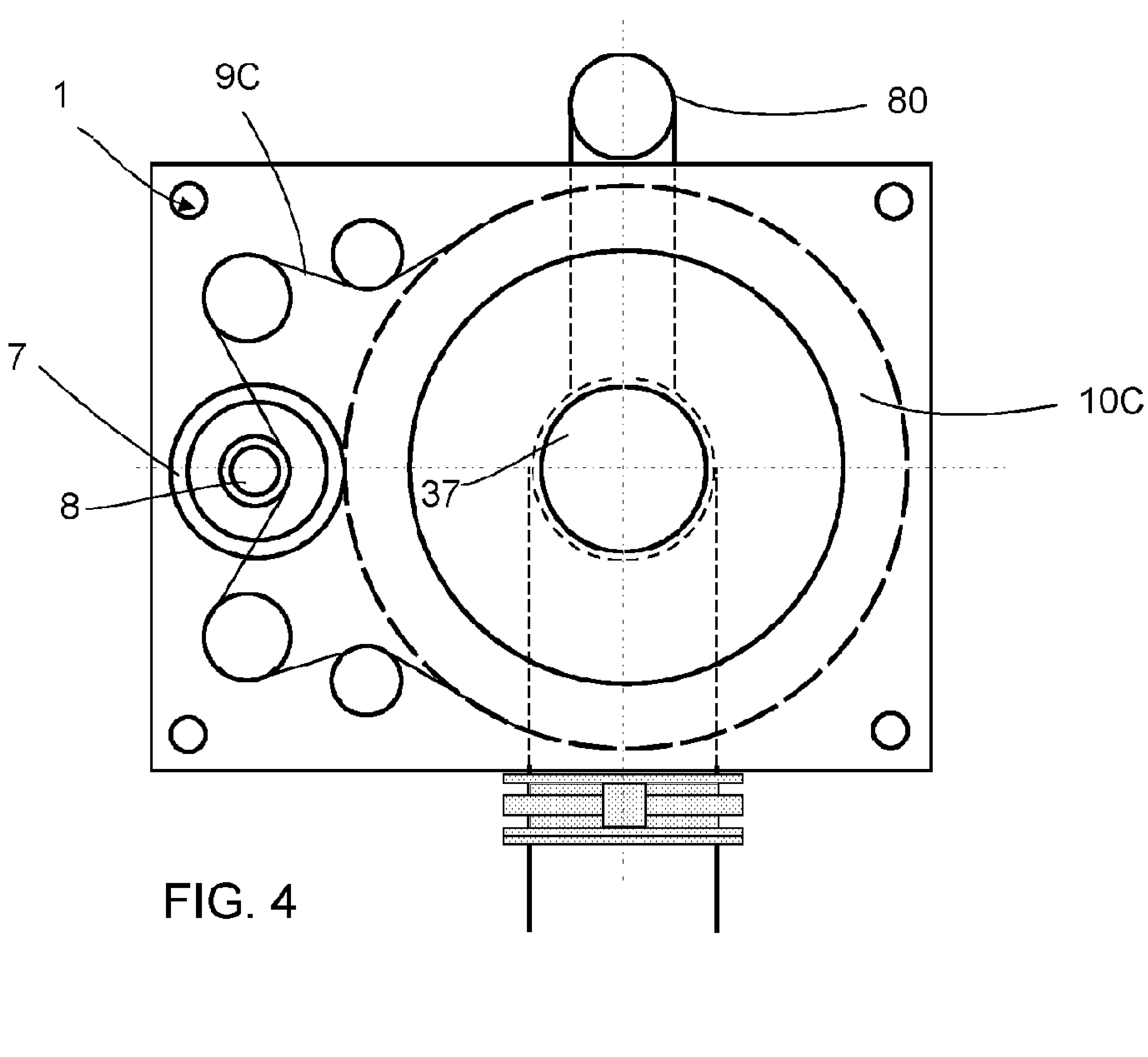

FIG. 4

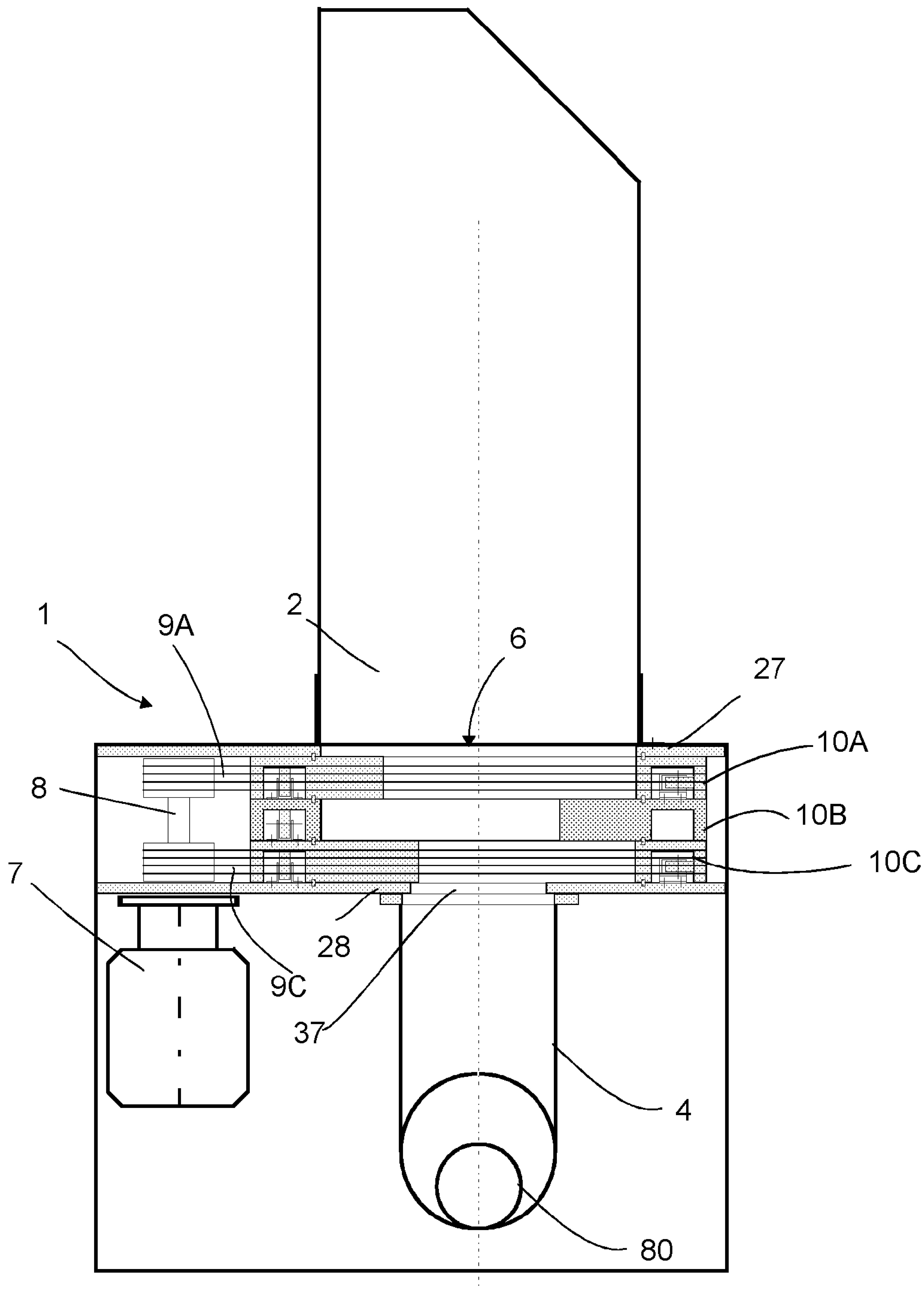

FIG. 5

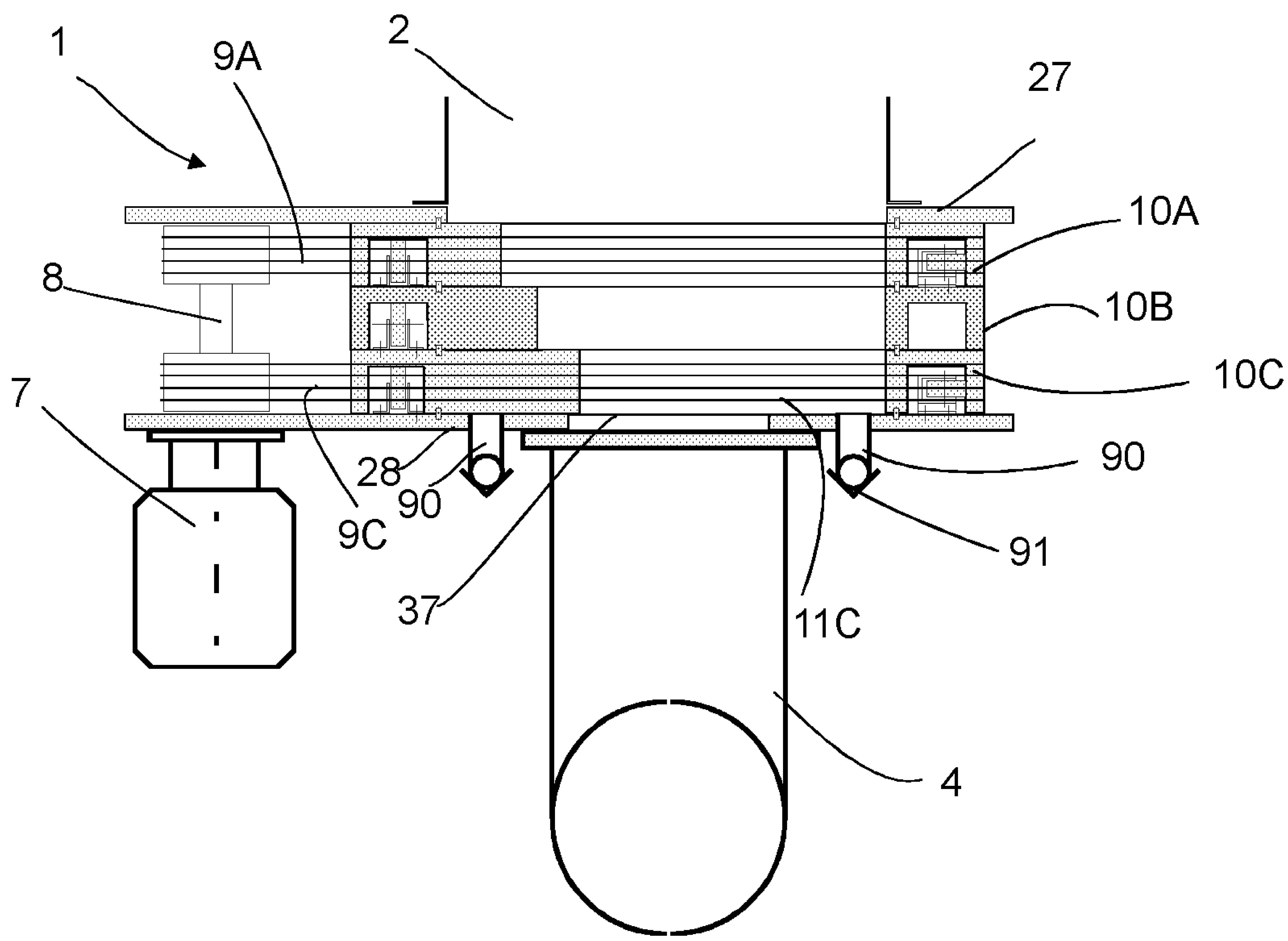

FIG. 6

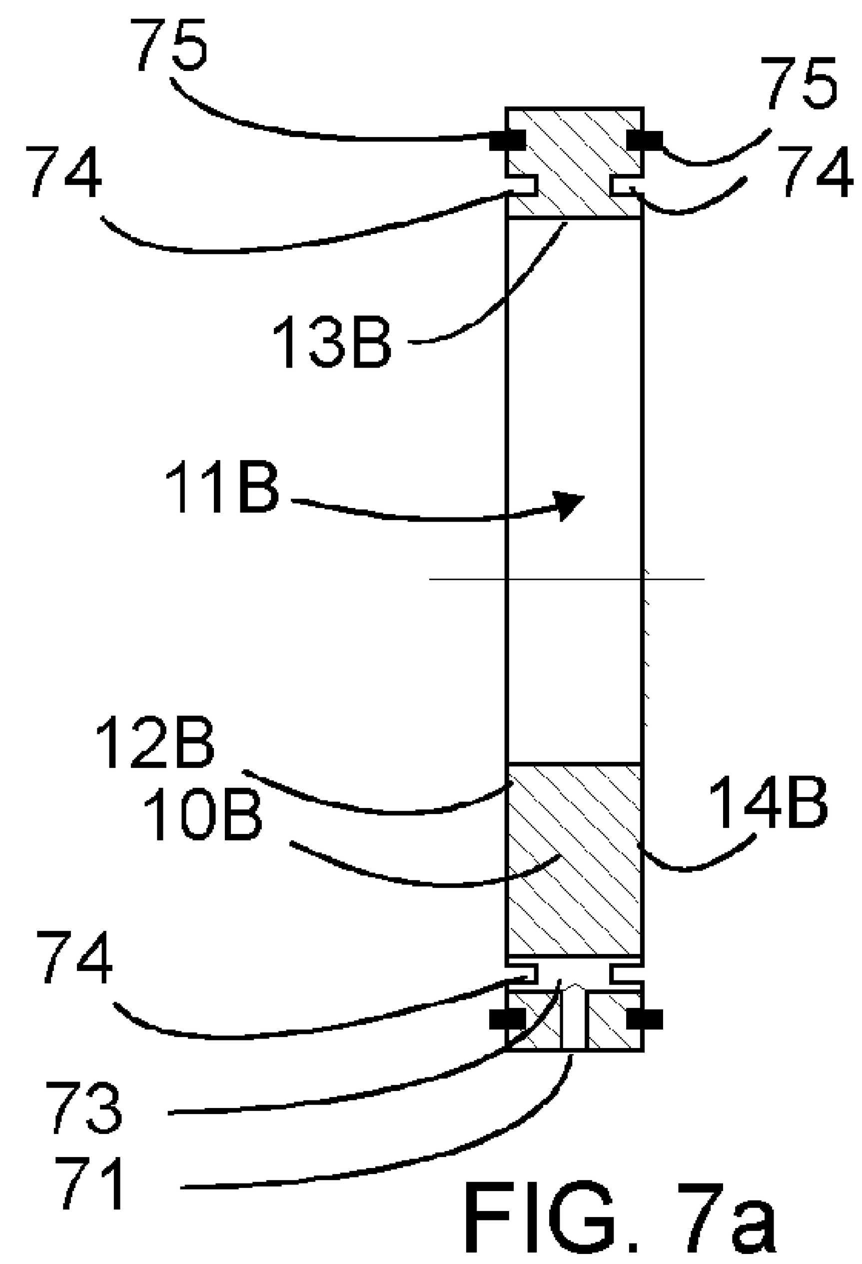

FIG. 7a

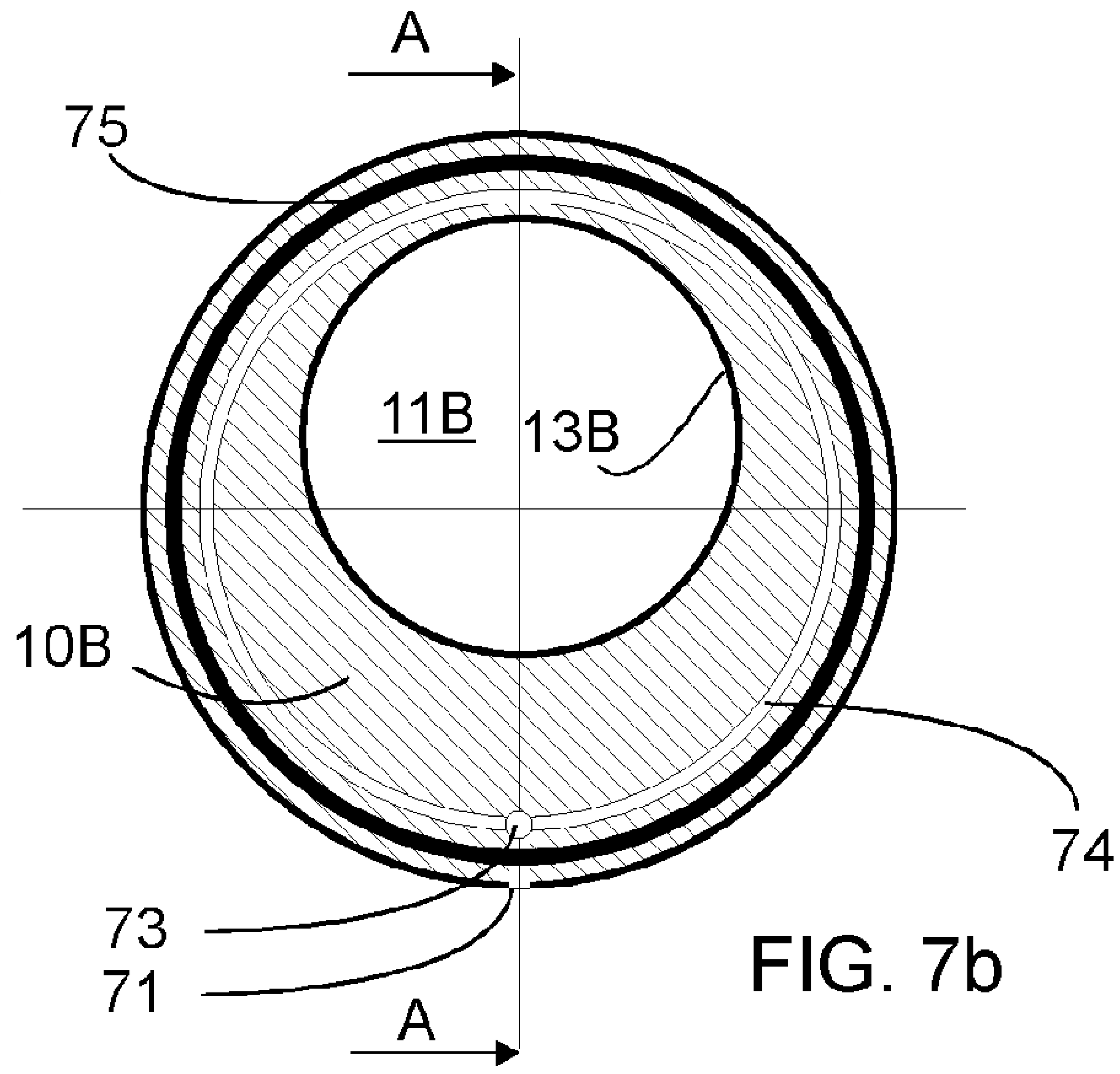

FIG. 7b

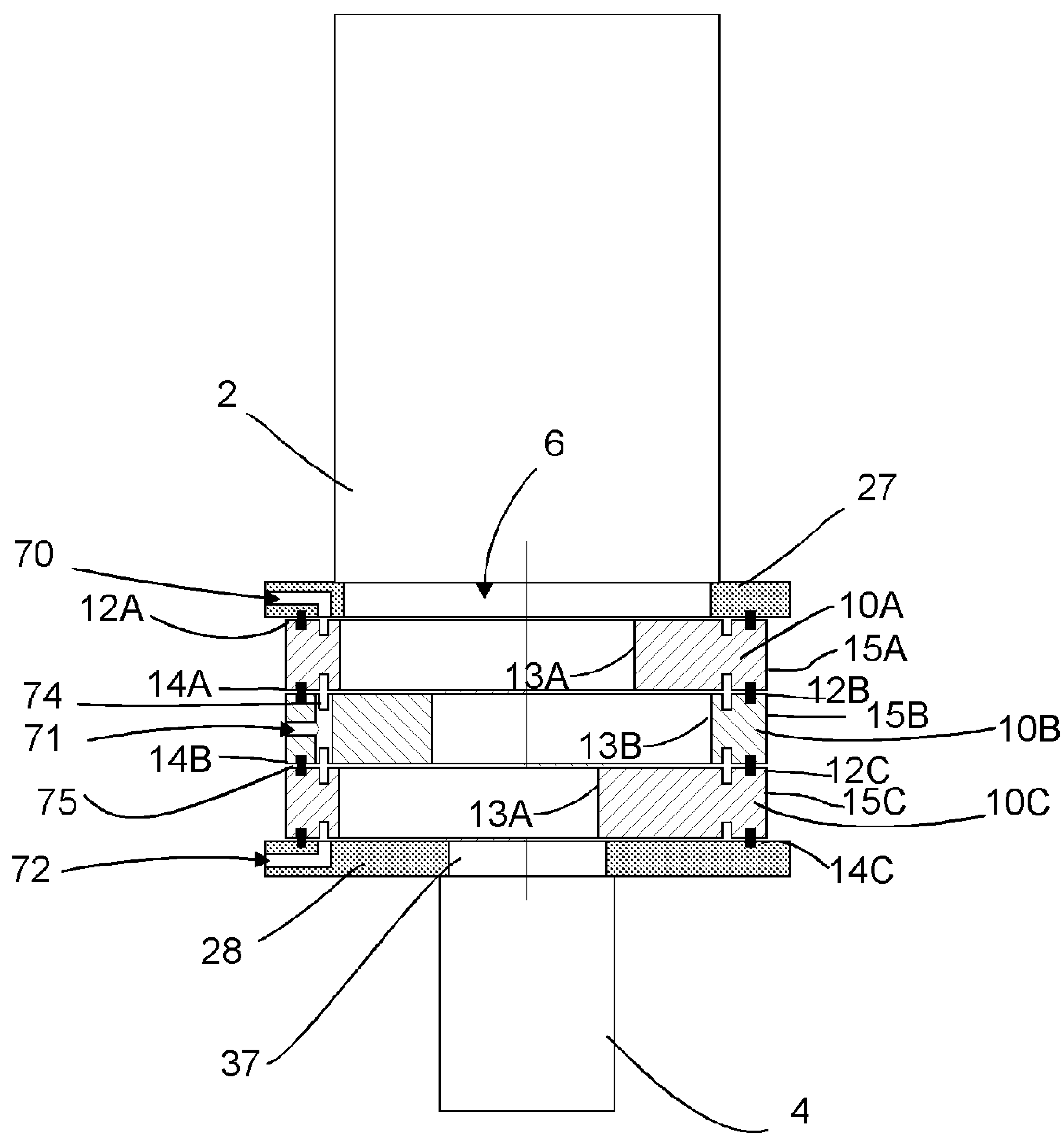

FIG. 7

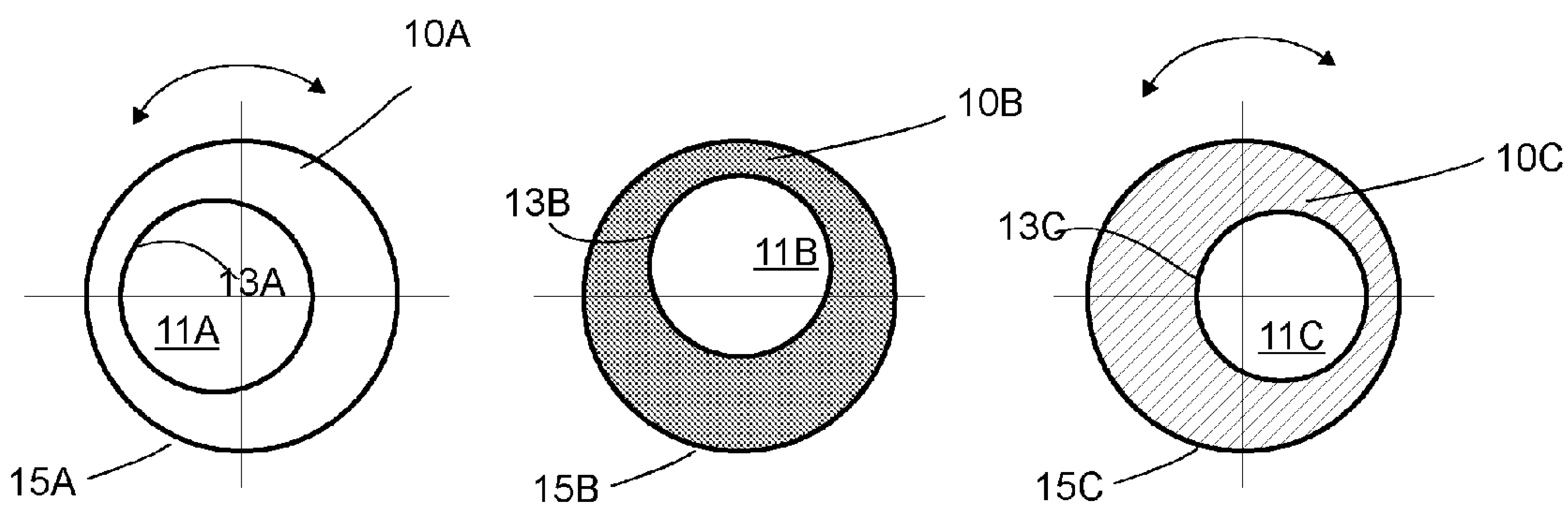

FIG. 8a FIG. 8b FIG. 8c

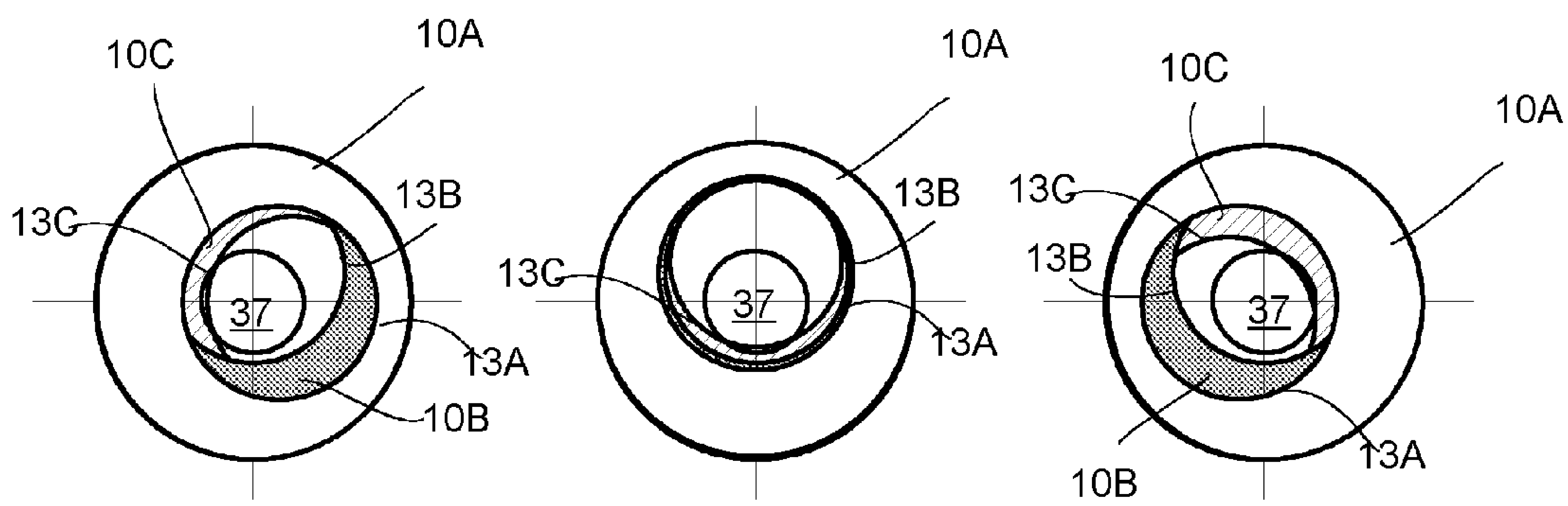

FIG. 9a FIG. 9b FIG. 9c

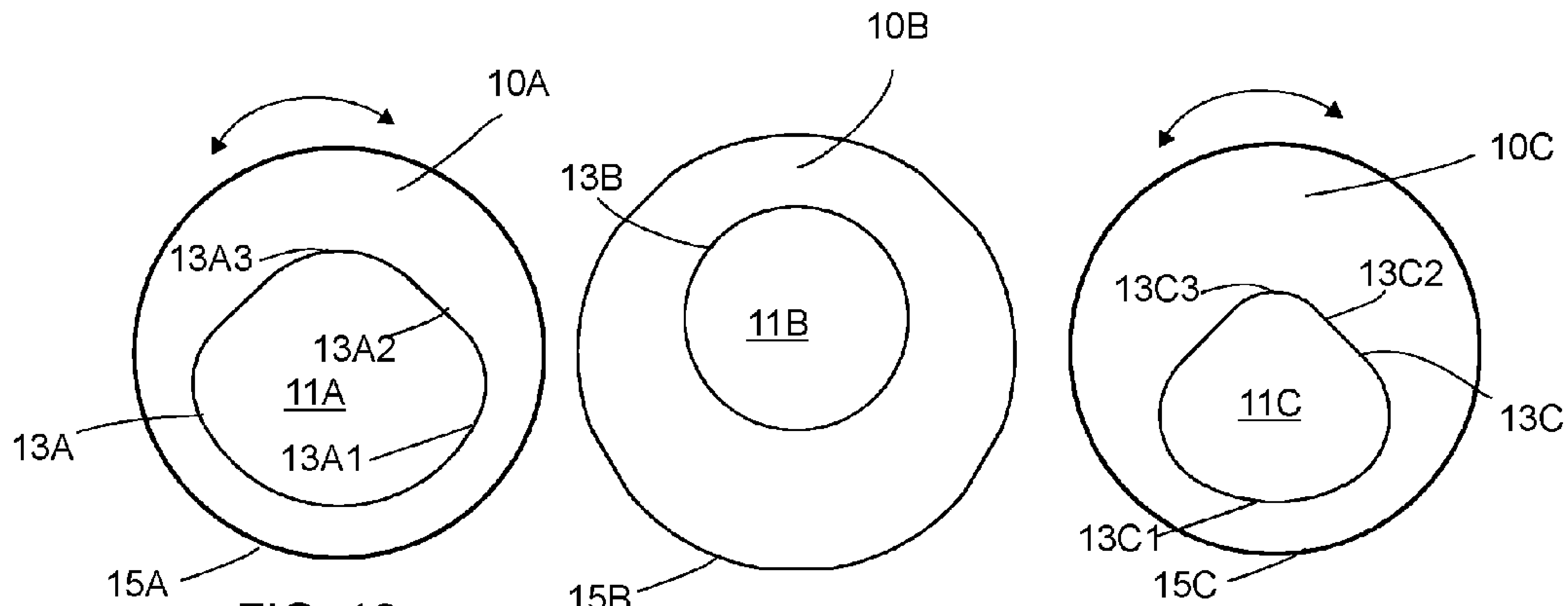

FIG. 10a FIG. 10b FIG. 10c

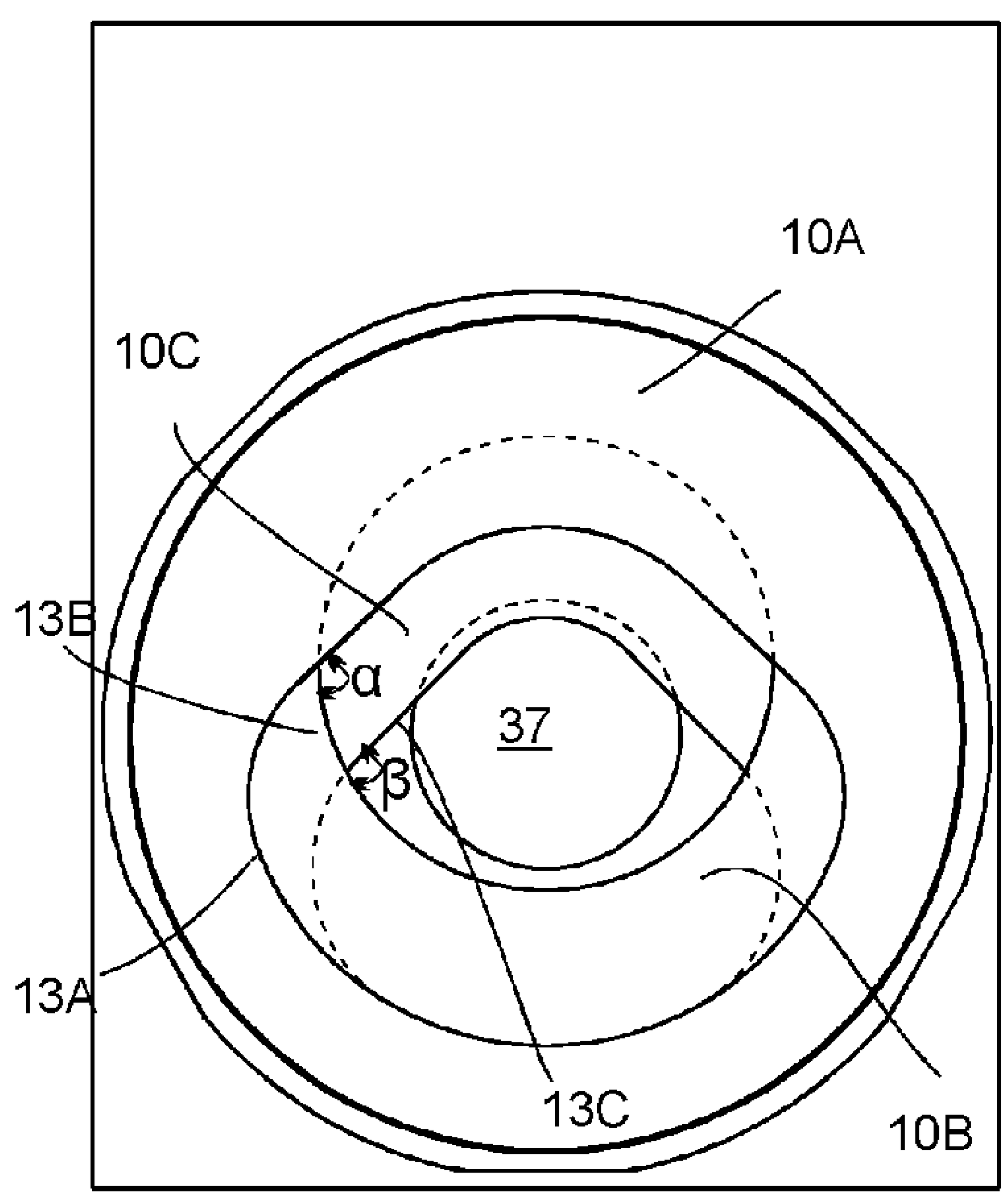

FIG. 11a

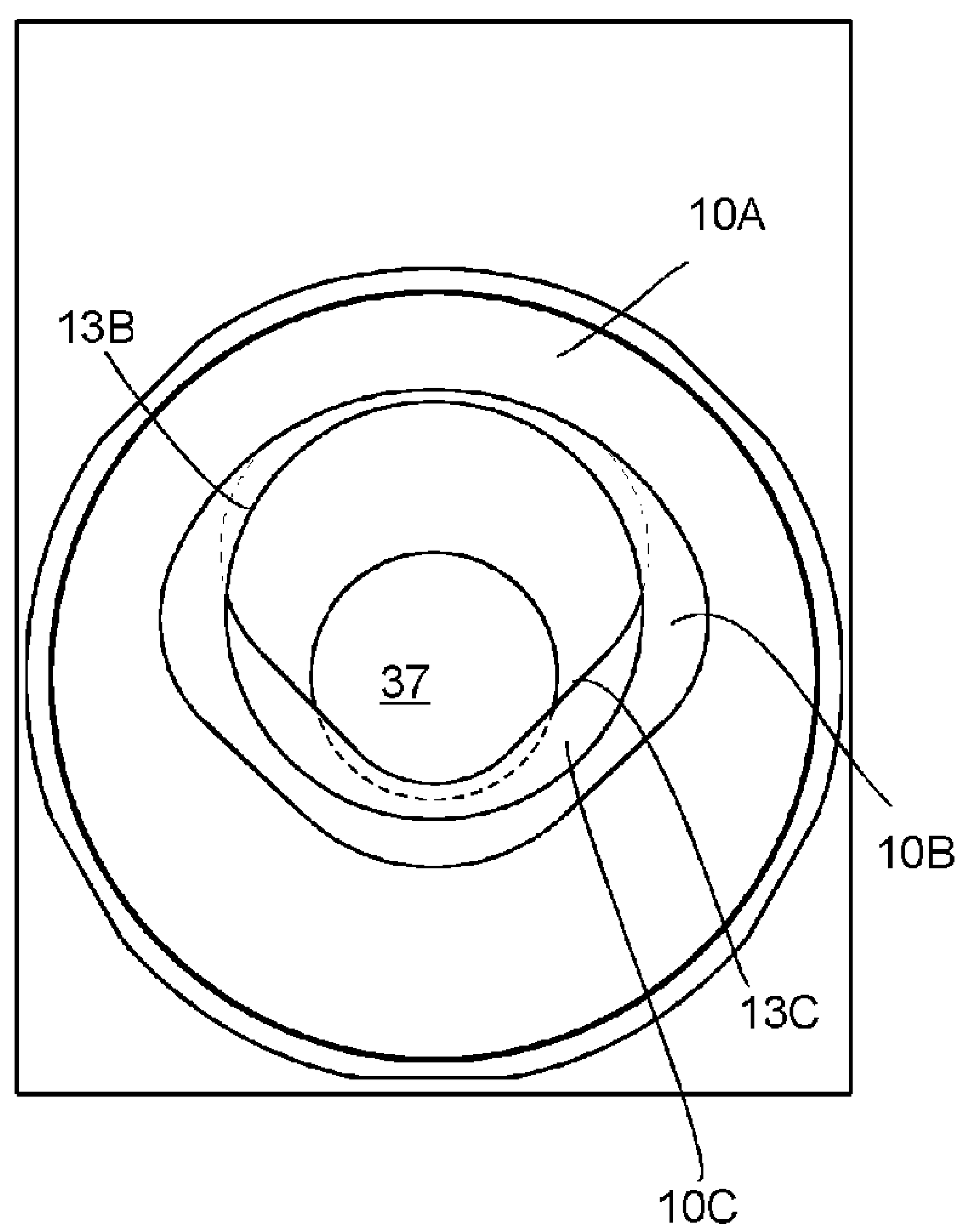

FIG. 11b

METHOD AND APPARATUS FOR HANDLING MATERIAL IN A PNEUMATIC MATERIALS HANDLING SYSTEM

BACKGROUND OF THE INVENTION

The object of the invention is a method as defined in the preamble of claim **1**.

The object of the invention is also an apparatus as defined in the preamble of claim **14**.

The invention relates generally to materials handling systems, such as partial-vacuum conveying systems, more particularly to the collection and moving of wastes, such as to the moving of household wastes.

Systems wherein wastes are moved in piping by means of an air current produced by a pressure difference or suction are known in the art. In these, wastes are moved long distances in the piping. It is typical to these systems that a partial-vacuum apparatus is used to bring about a pressure difference, in which apparatus a partial vacuum is achieved in the transfer pipe with partial-vacuum generators, such as with vacuum pumps or with an ejector apparatus. A transfer pipe typically comprises at least one valve means, by opening and closing which the replacement air coming into the transfer pipe is regulated. Input points at the input end of the material are used in the systems, from which input points the material, such as wastes, is transferred into the system. The system can also comprise refuse chutes into which material, such as waste material, is input and from which the material to be transferred is transferred into a transfer pipe by opening a discharge valve means, in which case, by means of the sucking effect achieved by the aid of the partial vacuum acting in the transfer pipe and also by means of the surrounding air pressure acting via the refuse chute, material such as e.g. waste material packed into bags, is transferred from the refuse chute into the transfer pipe. The pneumatic waste transfer systems in question can be utilized particularly well in densely populated urban areas. These types of areas have tall buildings, in which the input of wastes into a pneumatic waste transfer system is performed via a refuse chute arranged in the building.

The refuse chute is a vertical pipe, preferably comprising a number of input points, which are typically arranged in the wall of the refuse chute at a distance from each other. Tall buildings can comprise many tens, even hundreds, of storeys, in which case the refuse chute forms a very high pipe.

Wastes are transferred pneumatically in a closed system to the reception station, in which the wastes are compressed with a press only after transportation. The pipes of a pneumatic transfer system are in normal cases rather large in diameter, e.g. in the region of 500 mm in their diameter.

Also known in the art are solutions wherein a waste mill, such as a waste grinder, with which the wastes to be input are ground into small size, is arranged in connection with or in the proximity of a waste input location. A waste mill grinds wastes but does not compress the wastes. In the solution in question the blades of waste mills are also subjected to large stressing, in which case they must be replaced often.

Publication WO8203200 A1 discloses a device for fine-grinding, compressing and outputting a high-volume bulk good, more particularly household wastes, by means of which the waste material conducted through the device can be compacted. In the solution according to the publication large output powers are typically needed, especially in situations in which the device is used to cut or fine-grind a material, in which case the energy consumption of the drive devices and the costs of the drive devices are high. In addition, the passage of stones or other corresponding material between the cutting blades can produce breakage of the blades.

The aim of the present invention is to achieve a new type of solution in connection with input points of wastes, or in connection with refuse chutes or waste bins, by means of which the drawbacks of prior art will be avoided.

BRIEF DESCRIPTION OF THE INVENTION

The method according to the invention is mainly characterized by what is stated in the characterization part of claim **1**.

The method according to the invention is also characterized by what is stated in claims **2**-**13**.

The apparatus according to the invention is mainly characterized by what is stated in the characterization part of claim **14**.

The apparatus according to the invention is also characterized by what is stated in claims **13**-**27**.

The solution according to the invention has a number of important advantages. By means of the invention a particularly efficient solution for the handling of material, more particularly for pneumatic pipe transport, is achieved. With the solution according to the invention the material to be handled is made to be centered, i.e. is brought towards the center, in which case the material can be efficiently fitted into a transport pipe or a container. More particularly, waste material can with the solution according to the invention be efficiently compacted with the rotary shaper according to the invention and efficient transportation can be achieved with a significantly smaller pipe size compared to unshaped waste material. By using suction, in addition to gravity, to transfer the material to be handled from the rotary shaper into the transport pipe, an advantageous solution for a combination of a rotary shaper and pipe transport is achieved. By providing the rotary shaper with replacement air couplings arranged in it or in the proximity of it, an efficient supply of replacement air is achieved particularly in connection with a pneumatic materials handling system, such as a pipe transport system. Replacement air can be conducted into connection with the rotary shaper before the shaper, into the shaper and/or after the shaper. With a replacement air coupling arranged after the shaper, which coupling is connected to an output pipe or to a transfer pipe, effective starting into motion of handled material in the material transfer is achieved in the output pipe/transfer pipe. The conducting of replacement air can also be improved by conducting replacement air into the rotary shaper via at least one second replacement air coupling or aperture. Replacement air is guided directly or from between handling means that are one above the other or from between the support surfaces and the handling means into the handling apertures of the handling means and onwards into the output aperture and output pipe. Via the pathway of the medium, some medium, such as gas and/or liquid, can be conducted to the butt-end surfaces of the handling means. Typically the medium is air. The medium can, on the other hand, facilitate the rotation of the handling means by reducing friction between them and the surfaces supporting them. It can also be conceived that the air functions as some kind of bearing for the handling means. By means of the medium, more particularly with compressed air blowing, stone chips, glass chips and other such chips that cause wear can be prevented from going between the handling means and the support surfaces. The medium can also function as a type of air bearing for the shaping means. Further, it can be advantageous to bring about an air current by directing at least a part of the replacement air via the medium channels and/or from between the handling means such that in suction the seals admit inward air. In this case the air assists the transfer of the material to be handled in the rotary shaper towards the output aperture and onwards into the output aperture. Replacement air can be brought into the rotary shaper e.g. in a corresponding manner to what has been done in connection with refuse chutes, e.g. by applying the solution of publication WO/2009/130374 in connection with the rotary shaper. By adjusting the intake of replacement air, the operation of the apparatus can be optimized.

By forming the shape of the aperture of the handling means, an extremely efficient shaping of the material to be handled for onward transportation can be achieved. With a certain magnitude of the angle between the edges of the apertures of consecutive handling means, effective operation of the apparatus is achieved.

The handling devices of a rotary shaper are preferably driven with a drive device and with an applicable power transmission means. According to one preferred embodiment a belt transmission is used to transmit force. There can be one or more drive devices. When using hydraulic motors, the available torque can be increased by using two motors. The motors can be controlled on the basis of pressure, in which case at first both the rotatable handling means are driven with one shared motor and when the pressure of the system grows, owing to the material to be handled, the second motor is connected into use. In this case, according to the embodiment, the torque increases, e.g. doubles, and the speed of rotation decreases, e.g. halves. According to a second preferred embodiment the drive devices can be connected so that each rotatable handling means can, if necessary, be rotated with its own motor(s), in which case the direction of rotation can be changed individually, in which case the handling means can be rotated, if necessary, in opposite directions with respect to each other. Additionally, if necessary, the whole output power can be connected to drive only just one rotatable handling means. On the other hand, the material to be handled can be further compressed with a second compression phase arranged between the output aperture of the rotary shaper and the transport pipe, in which compression phase the press device is a piston-cylinder combination. With the second press device also the transfer of handled material into a transfer pipe is achieved.

BRIEF DESCRIPTION OF THE FIGURES

In the following, the invention will be described in more detail by the aid of an example of its embodiment with reference to the attached drawings, wherein

FIG. **1** presents a simplified embodiment of an apparatus according to the invention,

FIG. **2** presents a simplified embodiment of an apparatus according to the invention,

FIG. **3** presents a simplified and partially sectioned embodiment of an apparatus according to the invention,

FIG. **4** presents a simplified and partially sectioned embodiment of an apparatus according to the invention,

FIG. **5** presents a simplified embodiment of an apparatus according to the invention,

FIG. **6** presents a simplified and partially sectioned embodiment of an apparatus according to the invention,

FIG. **7** presents a simplified and partially sectioned embodiment of an apparatus according to the invention,

FIG. **7***a* presents a handling means of an apparatus according to the invention, sectioned along the line A-A of FIG. **7***b*,

FIG. **7***b* presents a handling means of an apparatus according to the invention,

FIG. **8***a* presents a simplified first rotatable handling means of an apparatus according to the invention,

FIG. **8***b* presents a simplified first stationary (non-rotatable) handling means of an apparatus according to the invention,

FIG. **8***c* presents a simplified second rotatable handling means of an apparatus according to the invention,

FIG. **9***a* presents a simplified view of one operating state of the first rotatable handling means, of the stationary handling means and of the second rotatable handling means of an apparatus according to the invention, as viewed in the input direction,

FIG. **9***b* presents a simplified view of a second operating state of the first rotatable handling means, of the stationary handling means and of the second rotatable handling means of an apparatus according to the invention, as viewed in the input direction,

FIG. **9***c* presents a simplified view of a third operating state of the first rotatable handling means, of the stationary handling means and of the second rotatable handling means of an apparatus according to the invention, as viewed in the input direction,

FIG. **10***a* presents a simplified embodiment of a first rotatable handling means of an apparatus according to the invention,

FIG. **10***b* presents a simplified embodiment of a first stationary (non-rotatable) handling means of an apparatus according to the invention,

FIG. **10***c* presents a simplified embodiment of a second rotatable handling means of an apparatus according to the invention,

FIG. **11***a* presents a simplified view of one operating state of the first rotatable handling means, of the stationary handling means and of the second rotatable handling means of an embodiment of an apparatus according to the invention, as viewed in the input direction,

FIG. **11***b* presents a simplified view of a second operating state of the first rotatable handling means, of the stationary handling means and of the second rotatable handling means an apparatus according to the invention, as viewed in the input direction.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** presents one embodiment of the solution according to the invention, in which the rotary shaper device **1** is arranged in connection with a refuse chute **3** or corresponding with a fitting part **2**. Only a part of the refuse chute is presented. The material, such as household waste, waste paper, cardboard or other waste, is input into a refuse chute **3** and from there onwards via a fitting part **2** into an input aperture **6** of the rotary shaper **1**. The material to be handled is shaped and compacted in the rotary shaper and after handling is conducted via an output coupling **4** into transfer piping **5** by means of suction and/or a pressure difference produced by e.g. the drive devices of a pneumatic pipe transport system. One advantage of the embodiment of the invention is that the waste material is made into a suitable shape, in which it fits for transferring in transport piping **4**, **5**. In this case transfer piping **5** that is significantly smaller in diameter can be used. According to one embodiment e.g. a pipe with a diameter in the region of 150-300 mm, preferably in the region of 200 mm, can be used as a transfer pipe **5**. According to the invention simultaneous suction is used in the embodiment, in which case the material to be handled can be influenced with suction or with a pressure difference acting via the transfer pipe **5** and the output coupling **4** when conducting the material through the handling means **10**A, **10**B, **10**C of the rotary shaper **1**. The handling means are rim-like, each of which has an aperture **11**A, **11**B, **11**C (FIGS. **8***a*, **8***b*, **8***c*, **10***a*, **10***b*, **10***c*) from the first side, from the input side, to the output side. At least a part of the handling means are rotated in the embodiment of the figure around the vertical axis with the drive device **7** and with the transmission means **8**, **9**A, **9**C. In the figure the topmost rotatable handling means **10**A and the bottommost rotatable handling means **10**C are rotated, and between them remains a non-rotating, stationary handling means **10**B. A valve means **55**, such as a disc valve, which is driven with a drive device **56** of the valve, can be below the rotary shaper **1**. The valve means **55** opens and closes the connection between the rotary shaper and the output coupling **4** and thus with the valve means **55** the suction effect from the transfer pipe into the rotary shaper is adjusted.

Correspondingly, according to the second embodiment of the invention, the rotary shaper is used in the embodiment of FIG. **2** in connection with an input point of the materials transfer system, such as in connection with an input point of kitchen waste. The rotary shaper **100** is adapted in connection with the feeder hopper **200** of an input point, in which case the material to be handled is input from the feeder hopper **200** into the input aperture **6** of the rotary shaper. In the rotary shaper the material is shaped into a suitable shape for transportation in piping and is conducted from the output coupling **400** to further handling, e.g. via the transfer piping **500** of a pneumatic pipe transport system.

FIG. **3** presents a part of one simplified embodiment of a rotary shaper according to the invention. In the figure the rotary shaper is presented without any drive devices of the shaping means. The rotary shaper comprises a frame, onto which ring-shaped handling means **10**A, **10**B, **10**C are arranged. In the vertical direction a plurality of ring-like handling means **10**A, **10**B, **10**C, which comprise an aperture **11**A, **11**B, **11**C leading from the first side to the second side of the ring, is arranged below the input aperture **6** of the material to be handled. The ring-like handling means are adapted in connection with a relative rotational movement around a geometric axis, which is mainly identical with the geometric axis of an input chute, to transfer an inputted bulk good into the center of the rings through the ring-like handling means by gravity and/or by means of the suction/pressure-difference produced by the partial-vacuum generators of a pneumatic materials handling system, such as of a pipe transport system, at least by shaping the bulk good simultaneously with the combined action of the rotating rings and at least one stationary (non-rotating) ring. The handling means **10**A, **10**B, **10**C can be adapted to rotate in opposite directions to each other, but as is presented in the figures in the preferred embodiment, every second ring-like handling means **10**B (in the figure, the centermost handling means **10**B) is fixed immovably to the frame and every second ring-like handling means **10**A, **10**C (in the figure, the topmost and the bottommost handling means) is fixed rotatably. The speed of rotation and the direction of rotation of the rotatable handling means can be varied. Additionally, according to one embodiment the rotary torque can be varied. The handling means **10**A, **10**C can be rotated individually according to one embodiment, in which case each handling means has its own drive device.

In FIG. **3** means for bringing replacement air into connection with the rotary shaper are arranged in connection with the rotary shaper. According to the figure the means comprise a replacement air coupling **80**, which is e.g. a pipe, which is connected to the output pipe **4** in the embodiment of the figure. A shut-off/adjustment means **81**, such as a valve, is arranged in the replacement air coupling **80** for adjusting

and/or for shutting off the intake of replacement air. The figure also presents a damping means **82**, such as a silencer, to which also a filter means can be connected. By providing the rotary shaper with replacement air couplings **80** arranged in it or in the proximity of it, an efficient supply of replacement air is achieved particularly in connection with a pneumatic materials handling system, such as a pipe transport system. Replacement air can be conducted into connection with the rotary shaper before the shaper, into the shaper and/or after the shaper. With a replacement air coupling **80** arranged after the shaper, which coupling is connected to an output pipe **4** or to a transfer pipe **5**, effective starting into motion of handled material in the material transfer is achieved in the output pipe/transfer pipe of a pneumatic pipe transport system. The apparatus comprises in the embodiment of the figure a valve means **51** arranged in the transfer pipe, with which means the connection between the transfer pipe **5** and the rotary shaper **1** can be closed and opened.

FIG. **4** presents a part of one simplified embodiment of a rotary shaper according to the invention. The figure diagrammatically presents the drive device **7** of the rotary shaper and the transmission of its power to the handling means. At least a part of the handling means **10**C are rotated in the embodiment of the figure around the vertical axis with the drive device **7** and with the transmission means **8**, **9**C. The ring-like handling means **10**C is adapted to function as a countersurface of the transmission means **9**C of the power transmission of the drive device **7**, e.g. for a belt means, which countersurface is included in the power transmission apparatus for bringing about rotation of the handling means **10**C.

FIG. **5** presents an apparatus according to an embodiment of the invention, partly sectioned according to the line V-V of FIG. **3**. In addition, the figure presents the drive device **7**, which is omitted from FIG. **3** for the sake of clarity.

FIG. **6** presents one embodiment of the apparatus according to the invention, in which at least one second replacement air coupling **90** is arranged in the rotary shaper **1**. At least one second replacement air coupling **90** is arranged in the base part **28**, from where there is a medium connection via the handling means **10**C of the rotary shaper to the output aperture **37**. In the figure, the pathway of the medium leads via the aperture **11**C of the handling means **10**C to the output aperture and onwards to the output pipe **4**. In the figure there are a number of replacement air couplings **90**, and they can be arranged in a distributed manner on a rim on the base part **28** around the fixing point of the output pipe **4**. With the second replacement air coupling **90** the intake of replacement air into the rotary shaper can be made more efficient, in which case the transfer of material from the rotary shaper towards the output aperture and into the output aperture is made more efficient. The second replacement air coupling can comprise a valve means **91**. The valve means **91** can be a suction valve, e.g. a rubber flap. On the other hand, according to one embodiment the second replacement air coupling **91** can also be e.g. an aperture formed in the base part **28**. The lid part of the rotary shaper is marked in the figures with the reference number **27**.

FIG. **7** presents a simplified and partially sectioned second embodiment of a rotary shaper according to the invention. In the figure the rotary shaper is presented without any drive devices and transmission means of the shaping means. The rotary shaper comprises a frame, onto which ring-shaped handling means **10**A, **10**B, **10**C are arranged. In the vertical direction a plurality of ring-like handling means **10**A, **10**B, **10**C, which comprise an aperture **11**A, **11**B, **11**C leading from the first side to the second side of the ring, is arranged below the input aperture **6** of the material to be handled. The ring-like handling means are adapted in connection with a relative rotational movement around a geometric axis, which is mainly identical with the geometric axis of an input chute, to transfer an inputted bulk good into the center of the rings through the ring-like handling means by gravity and/or by means of the suction/pressure-difference produced by the partial-vacuum generators of a pneumatic materials handling system, such as of a pipe transport system, at least by shaping the bulk good simultaneously with the combined action of the rotating rings and at least one stationary (non-rotating) ring. The handling means **10**A, **10**B, **10**C can be adapted to rotate in opposite directions to each other, but as is presented in the figures in the preferred embodiment, every second ring-like handling means **10**B (in the figure, the centermost handling means **10**B) is fixed immovably to the frame and every second ring-like handling means **10**A, **10**C (in the figure, the topmost and the bottommost handling means) is fixed rotatably. The speed of rotation and the direction of rotation of the rotatable handling means can be varied. Additionally, according to one embodiment the rotary torque can be varied. The handling means **10**A, **10**C can be rotated individually according to one embodiment, in which case each handling means has its own drive device.

The ring-like handling means **10**A, **10**B, **10**C, or at least a part of them, and the inner surface **13**A, **13**B, **13**C of their apertures **11**A, **11**B, **11**C are patterned and/or arranged to be such in their shape that their rotational movement simultaneously feeds material onwards from an aperture **11**A, **11**B, **11**C towards the output end and the output aperture **37**. Typically at least the rotating handling means **10**A, **10**C are arranged to be such that they transfer material towards the output end and the output coupling **4**.

The material conducted through the handling means **10**A, **10**B, **10**C in the rotary shaper is compressed and compacted. The output aperture **37** of the rotary shaper is, according to one embodiment, arranged to be to some extent smaller than the diameter of the next pipe, such as of the transfer pipe **4**, **5**. By forming the output aperture of the rotary shaper to be to some extent smaller than the diameter of the transport pipe, effective transfer of the handled material into the transport pipe by means of suction can be achieved.

The rotatable handling means are rotated by a drive device **7**, e.g. by means of a transmission means, such as a belt transmission **8**, **9**A, **9**C. The outer rim **15**A, **15**C of a ring-like handling means **10**A, **10**C is adapted to function as a countersurface of the transmission means of the power transmission of the drive device, e.g. for a belt means, which countersurface is included in the power transmission apparatus for bringing about rotation of a ring. The outer rim **15**A, **15**C of the handling means **10**A, **10**C can be shaped suitably. For example, a cambered or barrel-like shape has been observed to be very effective in one embodiment. The rotation trajectory of a handling means is achieved by arranging e.g. limiting means and/or bearing means and a countersurface to the ring-like handling means, most suitably a rim-like rolling surface or sliding surface, onto the rim of which the limiting means and/or bearing means are arranged in a distributed manner.

Typically the limiting means and/or bearing means are arranged between the bottommost ring-like handling means **10**C and the base part **28** of the frame part, between the bottommost ring-like handling means **10**C and the centermost, most suitably non-rotating, handling means **10**B, and between the non-rotating handling means **10**B and the topmost handling means **10**A. It can also be conceived that separate rolling means are not used, but instead the handling means are arranged to rest on one another and/or to rest on the base part **28** of the frame part. In this case the bringing of the medium to between the handling means and the support surfaces that is described below can be utilized.

In the embodiments of FIGS. **7**, **7***a* and **7***b* the rotary shaper is provided with means for conducting the medium to the butt-end surfaces of the handling means. According to FIG. **7**, pathways **70**, **71**, **72** of the medium are formed in the non-rotating lid plate and in the base plate of the device as well as in the non-rotating handling means, with which pathways medium can be conducted to the surface that is against the rotatable handling means **10**A, **10**C. According to FIGS. **7***a* and **7***b*, the pathway of the medium is in connection with a groove **74** opening towards the surface. The handling means and/or the lid part and the base part comprise a sealing means **75**. Via the pathway of the medium, some medium, such as gas and/or liquid, can be conducted to the butt-end surfaces of the handling means. Typically the medium is air. The air can come as replacement air from the effect of suction produced by the pneumatic system into the piping **4**, **5** or it can be delivered with a pump device, such as with an air compressor (not shown). The medium can, on the other hand, facilitate the rotation of the handling means by reducing friction between them and the surfaces supporting them. It can also be conceived that the air functions as some kind of bearing for the handling means.

By means of the medium, more particularly with compressed air blowing, stone chips, glass chips and other such chips that cause wear can be prevented from going between the handling means and the support surfaces. As explained above, this can also function as a type of air bearing.

Further, it can be advantageous to bring about an air current by directing at least a part of the replacement air via the medium channels **70**, **71**, **72**, **73**, **74** and/or from between the handling means such that in suction the seals **75** admit inward air. In this case the air assists the transfer of the material to be handled in the rotary shaper towards the output aperture and onwards into the output aperture **37**.

The diameter of the output aperture **37** is thus in one embodiment to some extent smaller than the diameter of the section of transfer pipe **4**, **5** following it. According to one embodiment the diameter of the output aperture is at least 2-20 percent, preferably 4-15 percent, smaller than the section of transfer pipe following it. In this case, when the suction is on, the material to be handled does not stick to the inside wall of the pipe but instead immediately accelerates into motion. According to a second embodiment the output aperture is at least 5 percent smaller than the section of transfer pipe following it. In one embodiment the diameter of the output aperture **37** is 180 mm, in which case the diameter of the transfer pipe is 210 mm. According to one embodiment the cross-sectional area of the smallest rotation rim of a handling means is, however, typically smaller than the cross-sectional area of an output aperture. According to one embodiment the diameter of the smallest rotation rim is at least 2-20 percent, preferably 4-15 percent, smaller than the diameter of the receiving aperture following it. In this case, when the suction is on, the material to be handled does not stick to the inside wall of the aperture but instead immediately accelerates into motion. According to a second embodiment, the rotation rim is at least 5 percent smaller than the diameter of the receiving aperture following it. In this case material can be conducted efficiently from the rotary shaper via the output aperture into the transfer piping.

The rotational movement of the handling means **10**A, **10**C can be achieved e.g. with an electric motor or with other arrangements. According to a second embodiment the rotational movement is achieved with a hydraulic motor such that both the rotatable handling means **10**A, **100** are rotated with two shared hydraulic motors **7**. In this case in the normal operating process both the handling means **10**A, **100** can be rotated with one motor.

In the embodiment according to FIGS. **8***a*, **8***b*, **8***c*, handling means that have a round shape of the aperture **11**A, **11**B, **11**C are presented. The apertures are arranged eccentrically with respect to the axis of rotation of the handling means. The aperture **11**A, **11**B, **11**C of each handling means has an inner surface **13**A, **13**B, **13**C. The inner surface of the apertures of the handling means shape the material to be handled. FIGS. **9***a*, **9***b*, **9***c* illustrate different situations when the shaping means are moved during the handling of the material.

The rotary shaper thus functions in a way as a re-arranger and compactor (i.e. as a formatter). Under the effect of suction the handling means **10**A, **100** of the rotary shaper shape the material to be handled so that it fits into an output aperture **37**.

In the case of FIGS. **8***a*-**8***c*, the shape of the aperture **11**A, **11**B, **11**C of the handling means is a symmetrical hole (shape), e.g. round. It can be conceived that it is also some other shape, such as oval. In this case the direction of rotation can be varied. Should too large a load arise, the wheel stops and the direction of rotation is changed. When the load increases to be too large for one of the rotatable handling means, its direction of rotation is changed. The rotation is preferably detected with a motion sensor, e.g. from the diverting pulleys of the drive apparatus and/or from a pressure sensor of the hydraulics.

The apertures of the handling means can be of different sizes and in a different position with respect to the center, so that the loading can be efficiently distributed and that a sufficiently large aperture for waste is obtained.

It has been shown that the power required is extremely small, e.g. in the region of only 2-3 kW.

The handling means **10**A, **10**C can thus be rotated in opposite directions with respect to each other, in which case the material to be handled does not start to rotate along with the handling means. Rotation of the material would disrupt shaping of the material into the desired shape.

It is also advantageous to rotate the handling means at a different speed, because then the compression on each cycle changes at different points and a suitable compression for each waste is always obtained at some point.

With specific types of material, such as with cardboard and paperboard, a compressor means (not presented in the figures) can also be used, which compressor means compresses the waste against the handling means from above.

This waste type probably also requires the aforementioned inner surface **13**A, **13**B, **13**C of the shaped apertures **11**A, **11**B, **11**C, which inner surface partly rips apart the cardboard and feeds it onwards.

Cardboard or other corresponding material types are typically challenging for pneumatic transportation, because a bent sheet easily opens and spreads against the inner surface of the piping and allows the air to pass it. With the apparatus according to the invention it is compacted and shaped into a suitable "cartridge", which is suited to the transport piping.

When the handling means **10**A is rotating, the inner surface **13**A determines the through-passage aperture **11**A through the handling means, which aperture is free of obstacles. Means, such as a threaded groove or a band, which when the handling means rotates in the input direction at the same time feeds the material to be handled from the aperture **11**A onwards in the handling direction, can thus be formed on the inner surface **13**A of a handling means.

In the rotary shaper according to the invention a non-rotating handling means **10**B is adapted below and supports the topmost rotating handling means **10**A, which non-rotating handling means is fixed to the housing with fixing elements. The non-moving handling means **10**B is typically formed in a corresponding manner to the rotating ring **10**A described earlier.

In a corresponding manner the second rotatable handling means **10**C also comprises an aperture **11**C, which aperture comprises an inner surface **13**C, as is seen especially from the diagrammatic FIG. **8***c*.

According to one embodiment the aperture **11**A, **11**B, **11**C of each consecutive handling means is smaller in the transport direction of the material than the aperture of the preceding handling means, in which case the pathway towards the output aperture **37** narrows.

The bottommost rotating handling means **10**C is arranged rotatably on the base **28**, which comprises an output aperture **37** for feeding out via it the bulk good compressed by means of the rings.

FIGS. **10***a*, **10***b*, **10***c* present still another embodiment, in which the apertures **11**A, **11**C of the handling means, of at least the rotatable handling means, are different to those in FIGS. **8***a*, **8***b*, **8***c*.

The edge **13**A of the aperture **11**A of the first handling means **10**A presented by FIG. **10***a* has a shape containing an outer curved section **13A1** and a second inner curved section **13A3**. A mainly straight section **13A2** connects these curved sections. There are two straight sections, in which case the shape of the aperture narrows from the side of the outer curved section **13A1** towards the inner curved section. The radius of curvature of the first curved section is greater than the radius of curvature of the second curved section.

FIG. **10***b* presents a first stationary, non-rotatable handling means **10**B, which in the figure comprises a round aperture **11**B, which has an edge **13**B.

FIG. **10***c* presents a second rotatable handling means **11**C, which has an aperture **11**C, the edge **13**C of which has a shape containing an outer curved section **13C1** and a second inner curved section **13C3**. A mainly straight section **13C2** connects these curved sections. There are two straight sections, in which case the shape of the aperture narrows from the side of the outer curved section **13C1** towards the inner curved section **13C2**. The radius of curvature of the first curved section is greater than the radius of curvature of the second curved section. The size of the aperture of the second rotatable handling means is typically smaller than the size of the aperture of the first rotatable handling means.

FIGS. **11***a* and **11***b* present in simplified form a few different situations, as viewed in the input direction of the material, of the operation of the handling means **10**A, **10**B, **10**C of FIGS. **10***a*, **10***b*, **10***c*.

When the handling means **10**A, **10**C are made to rotate, via the drive device and the power transmission means, the inner surface **13**A of the aperture **11**A of the ring in the first ring **10**A acts on the material, such as on the household waste, that flows into the input chute **2** from the refuse chute **3**. A bulk good in this case is, on the one hand, pushed inwards towards the center of the ring and, on the other hand, downwards in the axial direction from the effect of gravity and/or from the effect of suction and/or from the effect of the means transferring the material, which means is achieved on the inner surface of the handling means. The bulk good in this case is forced into the grip of the inner surface **13**B of the non-moving ring **10**B disposed below the ring **10**A. The bulk good becomes shaped, compressed and in this case also transfers in this ring, on the one hand, inwards towards the center of the ring and, on the other hand, in the axial direction towards the next rotating ring **10**C. Radial variations are thus produced in connection with the transfer through all the rings during the simultaneous axial feed of the bulk good flow.

An angle α (alfa) forms between the inner surface **13**A of the aperture **11**A of the first handling means **10**A and the inner surface **13**B of the aperture **11**B of the second handling means **10**B at the point of their intersection point. FIG. **11***a* presents the angle α (alfa) on one side at the point of intersection of the edges **13**A, **13**B of the apertures **11**A, **11**B, but there is also an angle (not marked in the figure) on the second edge of the walls of the apertures, for which angle the same marking can be used generally in this context. It has been observed in tests that the angle α (alfa) between the edges of the apertures of handling means that are one above the other is in one embodiment larger than 45 degrees. In this case when at least the other of the handling means rotates the material behaves in the desired manner, shaping and transferring towards the center and not remaining "jammed" between the handling means at the point of the angle α (alfa) at the intersection point. When the edge of the aperture of the handling means is curved, the angle α (alfa) can be conceived to be formed between the straight tangents passing via the intersection points of the edges of the apertures.

Correspondingly, an angle β (beta) forms at the intersection point between the edges **13**B and **13**C of the apertures **11**B, **11**C of the second handling means **10**B and the third handling means **10**C. FIG. **11***a* presents the angle β (beta) on one side at the point of intersection of the edges **13**B, **13**C of the apertures **11**B, **11**C, but there is also an angle (not marked in the figure) on the second edge of the walls of the apertures, for which angle the same marking can be used generally in this context. It has been observed in tests that the angle β (beta) between the edges of the apertures of handling means that are one above the other is in one embodiment larger than 45 degrees. In this case when at least the other of the handling means rotates the material behaves in the desired manner, shaping and transferring towards the center and not remaining "jammed" between the handling means at the point of the angle alfa at the intersection point. When the edge of the aperture of the handling means is curved, the angle β (beta) can be conceived to be formed between the straight tangents passing via the intersection points of the edges of the apertures.

The magnitude of the angles α, β; alfa and beta remains in the desired range, according to one embodiment, although the direction of rotation of the rotatable handling means is varied.

The general operation of a prior-art rotary press is presented e.g. in publication WO8203200 A1, and it is not described in more detail in this publication.

The degree of shaping can be influenced with the size and shape of the apertures of the shaping means, and also with the patterning of the inner edge of the aperture. Household waste input as a shaped stream into the transfer pipe is transferred in the pipe onwards by means of suction and/or a pressure difference to the reception location, such as to a waste station or corresponding.

The invention thus relates to a method for handling material in a pneumatic materials handling system, in which material, such as waste material, is input from an input aperture of an input point, such as from the input aperture of a refuse chute **3** or of some other input point, and is handled with a shaping device **1**, arranged in connection with the input point or in the proximity of it, to be more compact and is transferred onwards. The shaping device **1** is a rotary shaper, which comprises rotatable handling means **10**A, **10**C, which comprise an aperture **11**A, **11**C, which is arranged eccentrically with respect to the axis of rotation, and which rotary shaper comprises at least one stationary handling means **10**B, in which case the material to be handled is conducted into the rotary shaper and/or through it at least partly by means of gravity and/or suction and/or a pressure difference, and that into connection with the rotary shaper, before it and/or into the rotary shaper and/or after the rotary shaper, replacement air is conducted with at least one replacement air coupling **80**, **90**.

According to one embodiment in the method the intake of replacement air is adjusted with a shut-off/adjustment means **81**, **91**.

According to one embodiment by means of the replacement air conducted into the transfer pipe **4**, **5** via the replacement air coupling **80** disposed after the rotary shaper, the start of movement of handled material is made more efficient.

According to one embodiment at least a part of the handling means **10**A, **10**C of the rotary shaper when rotating feeds the material to be handled through the handling means.

According to one embodiment the rotatable handling means **10**A, **100** shapes the material, together with at least one other preferably non-moving handling means **10**B.

According to one embodiment in the direction of travel of the material to be handled the cross-sectional area of the material flow passing through the handling means **10**A, **10**B, **100** of the rotary shaper is decreased such that the material can be conducted into the material transfer pipe **4**, **5** disposed after the rotary shaper.

According to one embodiment the direction of rotation of the rotatable handling means **10**A, **10**C can be varied.

According to one embodiment the rotatable handling means **10**A, **10**C are driven with a drive device **7** such that the torque can be varied.

According to one embodiment the direction of rotation of each rotatable handling means **10**A, **10**C can be varied individually.

According to one embodiment the drive device **7** of a rotatable handling means is an electric motor, a pneumatic motor or a hydraulic motor.

According to one embodiment the pneumatic materials handling system is a pipe transport system of material, more particularly of waste material.

According to one embodiment medium is brought to the gap between at least a part of the handling means **10**A, **10**B, **10**C and/or to the gap between the handling means **10**A, **10**B and the parts **27**, **28** supporting them.

According to one embodiment the mutual shape of the edges **13**A, **13**B, **13**C of the apertures of the handling means **10**A, **10**B, **10**C is adapted such that they center the input material independently of the direction of rotation of the rotatable handling means.

The invention also relates to an apparatus for handling material in a pneumatic materials handling system, such as in a pipe transport system, which comprises at least one input point, such as a refuse chute **3** or some other input point **200**, and a shaper device **1**, arranged in connection with the input point or in the proximity of it, and means for transferring material onwards in the transfer piping. The shaper device is a rotary shaper **1**, **100**, a part of the rim-like handling means **10**A **10**B **10**C of which are rotatable handling means **10**A, **10**C, and which handling means comprise an aperture **11**A, **11**B, **11**C, which is arranged eccentrically with respect to the axis of rotation of the rotatable handling means, and a part are stationary handling means **10**B, and that the material to be handled is adapted to be conducted into the rotary shaper and through it at least partly by means of gravity and/or suction and/or a pressure difference, and in that the apparatus comprises at least one replacement air coupling **80**, **90** for conducting replacement air into connection with the rotary shaper, before it and/or into the rotary shaper and/or after the rotary shaper.

According to one embodiment a shut-off/adjustment means **81**, **91** is arranged in at least one replacement air coupling **80**, **90**.

According to one embodiment at least one replacement air coupling **80** is adapted after the rotary shaper into a transfer pipe **4**, **5** or into a pipe leading into a transfer pipe.

According to one embodiment at least a part of the handling means **10**A, **10**B, **10**C of the rotary shaper comprises surface patterning or a corresponding means, such as a thread section, that feeds material, which surface patterning is adapted when the handling means **10**A, **10**C is rotated to transfer the material to be handled through the compression phase formed by the handling means of a rotary press.

According to one embodiment in the direction of travel of the material the cross-sectional area of the material pathway **11**A, **11**B, **11**C passing through the handling means **10**A, **10**B, **10**C of the rotary shaper decreases in the direction of travel of the material.

According to one embodiment the apparatus comprises channel means **70**, **71**, **72** arranged in connection with the shaping means for bringing medium to the support surface **12**A, **12**B, **12**C; **14**A, **14**B, **14**C of at least a part of the shaping means **10**A, **10**B, **10**C.

According to one embodiment an input coupling **70**, **71**, **72** for medium and channeling **73**, **74** for leading medium to the support surfaces **12**A, **12**B, **12**C; **14**A, **14**B, **14**C of a handling means or to between the handling means are arranged in the shaping means.

According to one embodiment the cross-sectional area inside the rotation rim that is smallest with respect to the axis of rotation in the radial direction of the edge **13**C of the aperture **11**C of the handling means of the rotary shaper is smaller than the cross-sectional area of the receiving aperture in the material transfer direction, such as the cross-sectional area of an output aperture **37**, an output pipe **4** or a transfer pipe **5**.

According to one embodiment the aperture **11**A, **11**B, **11**C of the handling means is disposed eccentrically with respect to the axis of rotation.

According to one embodiment at least in the input direction of the material the angle α; β alfa, beta formed by the edges **13**A, **13**B; **13**B, **13**C of the apertures **11**A, **11**B; **11**B, **11**C of two consecutive handling means **10**A, **10**B; **10**B, **10**C is greater than 45 degrees.

According to one embodiment the mutual shape of the edges **13**A, **13**B, **13**C of the apertures of the handling means **10**A, **10**B, **10**C is adapted such that they center the input material independently of the direction of rotation of the rotatable handling means **10**A, **10**C.

According to one embodiment the aperture **11**A, **11**B, **11**C of the handling means is round or oval in shape.

According to one embodiment the edge **13**A, **13**C of the aperture **11**A, **11**C of a handling means has a shape containing an outer curved section **13**A**1**, **13**C**1** and a second inner curved section **13**A**3**, **13**C**3**, which curved sections are connected with a mainly straight section **13**A**2**, **13**C**2**.

According to one embodiment the radius of curvature of the first curved section **13**A**1**, **13**C**1** is greater than the radius of curvature of the second curved section **13**A**3**, **13**C**3**.

Typically the material is waste material, such as waste material arranged in bags. The refuse chute can be adapted to be a part of a pneumatic waste transfer system or it can be a separate part, in which waste material is conducted into the waste room, waste container or corresponding.

It is obvious to the person skilled in the art that the invention is not limited to the embodiments presented above, but that it can be varied within the scope of the claims presented below. The characteristic features possibly presented in the description in conjunction with other characteristic features can, if necessary, also be used separately to each other.

The invention claimed is:

1. A method for handling material in a pneumatic materials handling system, comprising:

a rotary shaper device (**1**),

the rotary shaper device (**1**) including:

an input aperture (**6**),

two rotatable, ring-shaped handling means (**10**A, **10**C),

one stationary ring-shaped handling means (**10**B), and

at least one replacement air coupling (**80**, **90**) connected to the rotary shaper device (**1**),

wherein each of the handling means (**10**A, **10**B, **10**C) includes:

an aperture (**11**A, **11**B, **11**C) arranged eccentrically with respect to an axis of rotation of the corresponding rotatable handling means (**10**A, **10**C),

the method comprising:

receiving the material in the input aperture (**6**),

conducting replacement air into connection with the rotary shaper device (**1**),

rotating each of the two rotatable, ring-shaped handling means (**10**A, **10**C), and

conducting the material into and through the apertures (**11**A, **11**B, **11**C), at least partly by gravity, or by suction, or by a pressure difference, or

at least partly by a combination of two or more of the gravity, the suction, and the pressure difference.

2. The method according to claim **1**, the method further comprising:

adjusting intake of the replacement air with a shut off device or an adjustment device (**81**,**91**).

3. The method according to claim **1**, further comprising:

improving an efficiency of a start of movement of the handled material by arranging a shut off device or an adjustment device (**81**, **91**) in the at least one replacement air coupling (**80**, **90**).

4. The method according to claim **1**, wherein at least a part of the handling means (**10**A, **10**B, **10**C) comprises a surface patterning consisting of a thread section,

the method further comprising:

feeding the material to transfer piping (**5**) with the surface patterning, and

transferring the material when the two handling means (**10**A, **10**C) are rotated via a compression phase formed by rotation of the two handling means (**10**A, **10**C).

5. The method according to claim **1**, further comprising:

shaping the material with the two, ring-shape rotatable handling means (**10**A, **10**C) shapes the material, together with the stationary ring-shaped handling means (**10**B).

6. The method according claim **1**, wherein each of the apertures (**11**A, **11**B, **11**C) of the handling means (**10**A, **10**B, **10**C) has a cross-sectional area which provides a pathway for transferring the material, and

the method further comprising

decreasing a speed of travel of the material through the cross-sectional areas of the apertures (**11**A, **11**B, **11**C) in the handling means (**10**A, **10**B, **10**C) in a direction of travel of the material.

7. The method according to claim **1**, further comprising:

varying a direction of rotation of the rotatable handling means (**10**A, **10**C).

8. The method according to claim **1**, further comprising: driving the rotatable handling means (**10**A, **10**C) with a drive device (**7**) in order to vary a torque.

9. The method according to claim **1**, further comprising: individually varying a direction of rotation of the rotatable handling means (**10**A, **10**C).

10. The method according to claim **8**, wherein the drive device (**7**) of the rotatable handling means (**10**A, **10**C) is an electric motor, a pneumatic motor, or a hydraulic motor.

11. The method according to claim **1**, wherein the pneumatic materials handling system is a pipe transport system.

12. The method according to claim **1**, wherein each of the handling means (**10**A, **10**B) is supported by a part (**27**, **28**) and includes multiple support surfaces,

the method further comprising:

bringing a medium into a gap between at least a part of each of the handling means (**10**A, **10**B, **10**C) and

bringing the medium into another gap between each of the handling means (**10**A, **10**B, **10**C) and the corresponding one of the parts (**27**, **28**),

thereby reducing a number of chips that can cause wear from going between the handling means (**10**A, **10**B, **10**C) and the support surfaces, or facilitating rotation of the handling means (**10**A, **10**B, **10**C) by reducing friction between the handling means (**10**A, **10**B, **10**C) and the support surfaces.

13. The method according to claim **1**, the apparatus further comprising:

an edge (**13**A, **13**B, **13**C) on each of the apertures (**11**A, **11**B, **11**C),

the method further comprising:

forming a mutual shape of the edges (**13**A, **13**B, **13**C) of the apertures so that the edges (**13**A, **13**B, **13**C) of the apertures (**11**A, **11**B, **11**C) center the material independently of a direction of rotation of the rotatable handling means (**10**A, **10**C).

14. The method according to claim **1**, wherein each of the apertures (**11**A, **11**B, **11**C) includes a continuous edge (**13**A, **13**B, **13**C) which forms a continuously curving closed surface surrounding the axis of rotation of the corresponding rotatable handling means (**10**A, **10**C).

15. An apparatus for handling material in a pneumatic materials handling system, comprising:

a rotary shaper device (**1**),

the rotary shaper device (**1**) including:

at least one input aperture (**6**) adapted to receive the material to be handled,

two rotatable, ring-shaped handling means (**10**A, **10**C),

one stationary ring-shaped handling means (**10**B), and

at least one replacement air coupling (**80**, **90**) for conducting replacement air into connection with the rotary shaper device (**1**),

wherein each of the handling means (**10**A, **10**B, **10**C) includes:

an aperture (**11**A, **11**B, **11**C) arranged eccentrically with respect to an axis of rotation of the corresponding rotatable handling means (**10**A, **10**C), and

wherein the material to be handled is adapted to be conducted into and through the rotary shaper device (**1**) at least partly by gravity, or by suction, or by a pressure difference, or

at least partly by a combination of two or more of the gravity, the suction, and the pressure difference.

16. The apparatus according to claim **15**, further comprising:

a shut off device or an adjustment device (**81**, **91**) arranged in the at least one replacement air coupling (**80**, **90**).

17. The apparatus according to claim **15**, further comprising:

at least one replacement air coupling (**80**) fitted below the rotary shaper device (**1**) and into an output coupling (**4**), or into a pipe leading into a transfer piping (**5**).

18. The apparatus according to claim **15**,

wherein at least a part of the handling means (**10**A, **10**B, **10**C) comprises a surface patterning consisting of a thread section, that feeds the material, and

the surface patterning is adapted to transfer the material when the two handling means (**10**A, **10**C) are rotated via a compression phase formed by rotation of the two handling means (**10**A, **10**C).

19. The apparatus according to claim **15**,

wherein each of the apertures (**11**A, **11**B, **11**C) of the handling means (**10**A, **10**B, **10**C) has a cross-sectional area which provides a pathway for transferring the material, and

a speed of travel of the material through the cross-sectional areas of the apertures (**11**A, **11**B, **11**C) in the handling means (**10**A, **10**B, **10**C) decreases in a direction of travel of the material.

20. The apparatus according to claim **15**, further comprising:

a lid part (**27**) above an upper most one the handling means (**10**A),

a base part (**28**) below a lowest one of the handling means (**10**C),

a first channel (**70**) arranged in connection with the handling means (**10**A) for bringing a medium to a support surface (**12**A) of at least a part of the handling means (**10**A),

a second channel (**71**) arranged in connection with the handling means (**10**A, **10**B) for bringing the medium to a support surface (**14**A) of at least a part of the handling means (**10**A) and a medium to a support surface (**14**B) of at least a part of the handling means (**10**C),

a third channel (**72**) arranged in connection with the handling means (**10**C) for bringing the medium to a support surface (**14**C) of at least a part of the handling means (**10**C),

thereby reducing a number of chips that can cause wear from going between the handling means (**10**A, **10**B, **10**C) and the support surfaces, or facilitating rotation of the handling means (**10**A, **10**B, **10**C) by reducing friction between the handling means (**10**A, **10**B, **10**C) and the support surfaces.

21. The apparatus according to claim **15**, further comprising:

channeling (**73**, **74**) adapted to lead a medium to a support surface (**14**A) of the handling means (**10**A),

to lead the medium to a support surface (**14**C) of the handling means (**10**C), and

to lead the medium between individual ones of the handling means (**10**A, **10**B, **10**C)),

thereby reducing a number of chips that can cause wear from going between the handling means (**10**A, **10**B, **10**C) and the support surfaces, or facilitating rotation of the handling means (**10**A, **10**B, **10**C) by reducing friction between the handling means (**10**A, **10**B, **10**C) and the support surfaces.

22. The apparatus according to claim **15**, further comprising:

a transfer pipe (**5**) arranged under a lowest one of the two rotatable, ring-shaped handling means (**10**C); and

an edge (**13**A, **13**B, **13**C) on each of the apertures (**11**A, **11**B, **11**C), wherein the two rotatable, ring-shaped handling means (**10**A, **10**C) have axes of rotation along a central axis of a refuse chute (**3**) of the rotary shaper device (**1**),

the aperture (**11**C) of the lowest one of the two rotatable, ring-shaped handling means (**10**C) is disposed in a radial direction with respect to the central axis of the refuse chute (**3**), and

the transfer pipe (**5**) has a diameter smaller than the aperture (**11**C) of the lowest one of the two rotatable, ring-shaped handling means (**10**C.

23. The apparatus according to claim **15**, further comprising:

an outlet aperture (**37**) arranged under a lowest one of the two rotatable, ring-shaped handling means (**10**C); and

an edge (**13**A, **13**B, **13**C) on each of the apertures (**11**A, **11**B, **11**C),

wherein the two rotatable, ring-shaped handling means (**10**A, **10**C) have axes of rotation along a longitudinal axis of a refuse chute (**3**) of the rotary shaper device (**1**),

the aperture (**11**C) of the lowest one of the two rotatable, ring-shaped handling means (**10**C) is disposed eccentrically with respect to the longitudinal axis of the refuse chute (**3**), and

the outlet aperture (**37**) has a diameter smaller than the aperture (**11**C) of the lowest one of the two rotatable, ring-shaped handling means (**10**C).

24. The apparatus according to claim **15**, further comprising:

an edge (**13**A, **13**B, **13**C) on each of the apertures (**11**A, **11**B, **11**C),

wherein an input direction of the material the angle ($\alpha;\beta$) formed by the edges (**13**A, **13**B) of the apertures (**11**A, **11**B) of two consecutive ones of the handling means (**10**A, **10**B) is greater than 45 degrees, and

the input direction of the material the angle ($\alpha;\beta$) formed by the edges (**13**B, **13**C) of the apertures (**11**B, **11**C) of two consecutive ones of the handling means (**10**B, **10**C) is greater than 45 degrees.

25. The apparatus according to claim **15**, further comprising:

an edge (**13**A, **13**B, **13**C) on each of the apertures (**11**A, **11**B, **11**C), and

a mutual shape of the edges (**13**A, **13**B, **13**C) of the apertures is adapted such that the edges (**13**A, **13**B, **13**C) of the apertures (**11**A, **11**B, **11**C) center the material independently of a direction of rotation of the rotatable handling means (**10**A, **10**C).

26. The apparatus according to claim **15**,

wherein the aperture (**11**A, **11**B, **11**C) of the handling means is round or oval in shape.

27. The apparatus according to claim **15**, further comprising:

an edge (**13**A, **13**B, **13**C) on each of the apertures (**11**A, **11**B, **11**C),

wherein the edges (**13**A, **13**C) of the apertures (**11**A, **11**C) have shapes containing an outer curved section (**13A1**, **13C1**) and a second inner curved section (**13A3**, **13C3**), and

the curved sections (**13A3**, **13C3**)are connected with sections (**13A2**, **13C2**) that are substantially straight.

28. The apparatus according to claim **27**, further comprising:

an edge (**13**A, **13**B, **13**C), the outer curved section (**13A1**, **13C1**), the second curved section (**13A3**, **13C3**), and a third curved section (**13A3**) on each of the apertures (**11**A, **11**B, **11**C), and

a radius of curvature of the outer curved section (**13A1**, **13C1**) is greater than the radius of curvature of the second curved section (**13A3**, **13C3**).

29. The apparatus according to claim **15**, wherein each of the apertures (**11**A, **11**B, **11**C) includes a continuous edge (**13**A, **13**B, **13**C) which forms a continuously curving closed surface surrounding the axis of rotation of the corresponding rotatable handling means (**10**A, **10**C).

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